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ASTRONOMY IN CANADA[1]

By Dr. OTTO KLOTZ

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LET me first extend greetings from my native country Canada to our nearest and closest neighbor and friend—you of the United States. Although two flags wave over our countries, there is only one celestial vault to cover us; the same stars smile on you as on us, and we both appeal to them to help solve the riddle of the universe. Our aims and our aspirations are, I think, the same—the uplift of our people, the utilization of all our resources for the common weal, the widest distribution of the amenities of life, but all founded on the eternal gospel of work.

I think we will find that the origin of all national observatories has been to supply a distinct want or need in the affairs of the nation concerned. So it was with the Royal Observatory at Greenwich and so it was with us. You will recall that it was essentially the question of determining longitude at sea that decided Charles II—in spite of the evil reputation he earned for himself—to command the Rev. John Flamsteed "to apply himself with care and diligence to improve the Table of the positions of the Fixed Stars and Moon to find out the much desired Longitude at Sea, for the perfecting the Art of Navigation." And so was founded the Royal Observatory in 1675. No thoughts of abstract science were in the minds of its founders. It was founded for the benefit of the Royal Navy, and that is its first object to the present day, although its field of activity has vastly expanded and comprises many lines of research. Now a few words as to the origin of the Dominion Observatory, the national observatory of Canada.

The original Dominion of Canada as born on the 1st of July, 1867, comprised the four provinces of Nova Scotia, New Brunswick, Lower and Upper Canada, or Quebec and Ontario. In 1871 British Columbia entered the Dominion, and amongst the terms of federation was that Canada was to build a railway to and through the province to the Pacific Ocean, while British Columbia on her part would convey to the Dominion all lands held by the Crown within 20 miles of the contemplated railway. I may say here that there was some difference of opinion as to what 20 miles meant along a naturally very sinuous railway of over 500 miles through a sea of mountains. There was of course only one correct interpretation, and that was the area covered or swept by a 20 mile long arm attached at right angles to each side of a moving train.

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[1] Subject matter given in an illustrated ex-tempore address before the Academy of Arts and Sciences, Brooklyn, on February 28, 1922.

It was decided by the Dominion Government that the lands to be acquired from British Columbia were to be coordinated with those of the northwest, the survey of which was based on astronomic positions. Although the rectangular system of surveys, the division of lands into sections, townships and ranges was copied from the United States, we in so far improved on it that our system is connected and is a unit, extending from the Lake of the Woods to the Pacific, and from the International Boundary of the 49th parallel to the Arctic Ocean, while in the United States the surveys of the individual states, where the rectangular system applies, are quite independent of each other, and hence lack coordination.

May I here, as I have mentioned the 49th parallel, say a word about its survey, as the astronomer played an important part therein.

You know it's so easy for diplomats sitting about a table to decide the fate of countries and their boundaries. With regard to the latter they are often in blissful ignorance of the geography involved or of the people affected. Certainly nothing could look nicer on paper than a parallel of latitude, which has so simple a definition, curving around the earth. Laying it down on the ground, however, is quite another story. The two astronomers engaged in this international work clearly recognized difficulties that might and would arise in observing for latitude and came to an understanding how to deal with the matter.

The understanding—and a very sensible one—was that the observed latitude was to govern, quite apart from the error that may be involved due to the deflection of the plumb line. The observations themselves, about 50 years ago, being practically devoid of error, were made with present-day accuracy.

The line zigzags, responding to the varying attraction or displacements of the zero of the level from normal. The greatest displacements were the ones to the north of 600 feet, due to the attraction of the Cypress Hills; and the other to the south of 800 feet, due to the attraction of the Sweet Grass Hills in Montana close to the boundary. That is, within a distance of less than a hundred miles we had a difference of 1,400 feet in the gravitational effect due to the unequal distribution of matter along the boundary line. This unequal distribution is not always visible as manifested by the hills spoken of; it might be hidden underneath the surface.

To return to the story of the evolution of the Dominion Observatory: The lands of that 20-mile railway belt in British Columbia were to be coordinated with the land system of the northwest immediately east of the Rocky Mountains. Meridians or parallels could not be projected over the mountains, so the railway itself on the eve of completion was made a base line by a special and very accurate survey. To secure its geographical position a number of astronomic stations were established along the line, and to them was joined the special railway survey. Thereby every part of the line became known by its geographical coordinates and hence surveys could be started where required for mines, timber or other purpose, and expressed in sections, townships and ranges. Thus was born astronomy, practical astronomy, in Canada as a function of the government. That little lamp lit in 1885 was tenderly cared for, fostered and developed and its usefulness extended so that 20 years later the government built the Dominion Observatory, the national observatory of Canada, fully equipped for astronomical and astrophysical work as well as for some branches in geophysical work—seismology, terrestrial magnetism and gravity, about each of which I shall make some brief remarks.

To the general public a dome is a *sine quâ non* for an observatory, and yet the fundamental work does not require it. By fundamental work I mean the determination of the accurate position of the sun, the moon, the planets and stars. And that is essentially the work of national observatories for the use of navigators, explorers and astronomers engaged in other lines of work. This work is done with the meridian circle. As its name implies, it is mounted in the meridian and is only movable therein.

The big telescope, the equatorial that can sweep the whole heavens from its dome, is particularly adapted for answering the question of the little rhyme, "Twinkle, twinkle, little star, how I wonder what you are?" That's it, what you are, not where you are (the meridian circle tells that), but what you are, what gases compose your being, have you a companion, what is your temperature, your mass?—there are queries which the equatorial with its attached spectroscope answers.

Our equatorial 15″ is at present used exclusively for the determination of radial velocity of stars forming binary systems, by means of the spectroscope. You all know the spectroscope, how the prisms in it break up the light into its constituent rays, each with its particular wave length, to be photographed on a narrow glass plate, together with some standard light. The motion of a star causes its spectrum to be shifted to or from fixed lines or fixed spectrum, depending upon the approach or recession of the star relative to the earth. The principle is the same as the change in pitch of a locomotive whistling when approaching or receding from a station. A marvel of the spectroscope is the separation of stars into a binary system when the most powerful telescope fails to see but one object, apparently the presence of only one star.

The success that had been attained in the determination of radial velocities led the government to secure a telescope of a far greater light-gathering power and to mount it where the climatic conditions were more favorable than at Ottawa, and particularly where there was an assurance of more clear nights in the year than obtained at the federal capital. Hence was built the Dominion Astrophysical Observatory at Victoria, British Columbia, and the results already achieved there have fully justified the decision. The largest equatorials are invariably reflectors. The one at Mount Wilson, California, has a diameter of 100 inches, while ours, the second largest, has a diameter of 72 inches or 6 feet. Perhaps the most spectacular and beautiful telescopic object in the heavens is the great nebula in Orion. Then there is the great nebula in Andromeda, the brightest one in the sky. Next we see the ring or annular nebula in the constellation of Lyra, which may be seen with even a small telescope. Contemplating these nebulæ, many questions flood the mind to which but very few answers are as yet available. The spectroscope as usual forms our interlocutor and gives us knowledge from the bright lines in their spectrum that they are incandescent gases under low pressure.

Thus by means of the spectroscope revelation after revelation is unfolded, and the fleet-footed messengers traveling at the rate of 186,000 miles a second come to us after their long, long journeys, some hundreds of years, many even thousands of years and bring the welcome news of their distant homes. Let me make a philosophical and perfectly logical statement based on what I have just said, and that is that no astronomer could give you absolute assurance that any stars that you may see to-night are really there, for the news from the nearest one takes over four years to reach us; that is, it would keep on shining for us four years after its extinction.

Another wonder in the heavens is found in the dense globular clusters, and of these the most splendid in the northern sky is the great cluster in Hercules, also known as Messier 13, in which there are more than 50,000 stars.

Mentioning this number may surprise some or most of you; when on a clear moonless winter night you look on the sky, you will be tempted to say, "What myriads of stars stud the celestial vault." That is poetic license. If you could count them, you would never get as many as 3,000, possibly 2,000 as seen by the naked eye, for there are not over 5,000 stars in the whole sky, northern and southern hemispheres, that can be seen with the unaided eye.

When you board a ship in New York bound for some foreign port, you have the utmost confidence of reaching your destination, but I am sure it never occurs to you that the astronomer has anything to do with it. Yet it is his labors that supply the captain with the data, as found in a nautical almanac, to guide the ship over the watery waste. This astronomic work is undertaken by all national observatories, the determination of fundamental star places. We also engage in this work. The instrument used is called a meridian circle, so named because it is mounted in the meridian, to which its motion is confined. During my own time the work of the astronomer has been greatly assisted by electrical devices. When I began observing—tell it not in Gath—half a century ago, we recorded by eye and ear; that is, with pencil in hand and listening to the beats of a chronometer or clock the transit of a star across the thread of a telescope was recorded. And what do we do to-day? The astronomer at the telescope turns a micrometer screw following the star, and in an adjoining room his observation is not only recorded but printed in hours, minutes and seconds and hundredths of a second on a continuous strip of paper, which can be copied at leisure the following morning. This certainly removes a lot of the drudgery of former days.

The meridian circle is essentially the instrument that furnishes time; although our daily life is regulated by the sun, yet the accurate time is invariably obtained from the stars, which can be far more accurately observed than can such a boiling cauldron as the sun. Has it ever occurred to you that every time you pull out your watch and look at the time you are paying silent tribute to the astronomer? So does every factory whistle that summons to work and every church bell that summons to devotion. The time of all trains in the country is derived from some astronomer—the silent watcher of the skies.

Although most investigational and research work is done amongst the stars, yet the most important celestial body for us, outside of our own earth, is the sun. Every living thing on this earth, vegetable or animal, life in any form, is but converted solar energy, crystallized sunbeams. We are nothing but animated sunbeams, which is a very good reason for giving us sunny dispositions. When we once know more about the behavior of the sun, how the firing is done and the stoking, what material is used for heating, and whether there is a rhythmic periodicity in the activities, when we know some of these things we will be able to forecast the conditions upon the earth.

The sun is under daily scrutiny, and is attacked from different angles. We are studying its rotation and problems involved therein, by means of the coelostat. The earth being a solid, every part of it revolves in the same time; but such is not the case with the sun, as it is a gaseous mass, in consequence of which the equatorial parts revolve faster than parts north or south thereof. The period of rotation of the former is about 26 days, while the polar regions require 4 to 5 days longer. The principle involved in determining the rotation of the sun is the same as that employed in determining the radial velocity of stars, the displacement of the lines in the spectrum caused by the moving body. Hence, if we obtain simultaneously the spectrum of the two limbs or edges of the sun, the one edge through the rotation will be approaching us, while the other one will be receding; the amount of displacement of the lines of the spectrum resulting therefrom will give us a measure of the speed of rotation. Occasionally you see here the Northern Lights, not quite as brilliantly as we have them in Canada, which sails more closely under the Great Bear or Dipper. These Northern Lights or the Aurora Borealis are a manifestation of solar activity, shooting out negatively charged particles into space and those intercepted by the earth, which at its distance from the sun can stop but the minutest fraction of the matter radiated, give the electric glow to the outermost regions of our atmosphere, encountering there hydrogen and helium, giving the whitish greenish tinge to the phenomenon. When the electrically charged particles penetrate deeper and into the region having the presence of nitrogen, the color becomes reddish.

We are engaged too in the study of relative star magnitudes and the variability of their light by photographic means. It seems scarcely necessary to point out that magnitudes determined photographically and by the eye are not necessarily, in fact not generally, the same. The rays of light that are most effective for vision are not the same as those most effective for photographic purposes. For the latter the rays of shorter wave lengths, those towards the blue or violet end of the spectrum are most active in producing a photographic image.

In the foregoing we have given but the briefest outline of the purely astronomic work carried on in the observatory itself, but we engage too in field astronomic work, which was required in the vast expanse of Canada in which up to recent times there were few accurate surveys, and hence the accurate position of points or places was necessary to put Canada properly geographically on the map.

We use a Cooke portable transit of 3 inches clear aperture, and a cement pier is always built for mounting it. The instrument is used both for latitude and longitude work, and such an instrument it was I carried with me around the world some years ago, when I completed the first astronomic girdle of the world, wiring the British Empire together astronomically. Whenever the electric telegraph is available we use it for the determination of longitude. We always connect up our standard sidereal clock at Ottawa with the place where longitude is to be determined even when thousands of miles away, as in British Columbia. But when there is no telegraph line we now resort to wireless. This is a very recent innovation in astronomic work, and we applied it extensively last season in the Mackenzie basin, due to the discovery of oil and the necessity of surveys, which had to be based on astronomic coordinates. Let me but indicate the principle involved in this wireless longitude work. The wireless expert with his outfit by chronometer records the arrival of wireless time signals from anywhere; in the above case he recorded those from Balboa, San Diego, Annapolis, San Francisco, Honolulu and Cavite in the Philippines. At Ottawa with our wireless outfit we record the same or at least some of the stations. The astronomer who is with the wireless expert furnishes him with the accurate local time when the signals were received. Comparison later on with Ottawa shows the difference of time between the two places; hence the longitude. It is to be observed that although the signals received are time signals—but most of no high degree of accuracy—we treat them as arbitrary signals, simply as signals noted accurately at two places. The question of the origin of the signal comes into consideration by a very minute quantity, *i. e.*, the difference in time it takes to reach the Mackenzie and Ottawa, as the velocity of transmission of the wireless or Hertzian waves is 186,000 miles a second, being the same as that of light.

May I relate a little incident of the Mackenzie on our wireless. It is not astronomic, far from it, but rather worldly. On the 2nd of July last (it was on a Saturday) there came flashing over the earth news in which many people, even nations, were interested, and that news was as promptly and as soon received by our expert in the boreal regions of the Mackenzie as it was probably here in New York, so near the source. To couch it in astronomic terms, the news may be stated that in the binary system Mr. Carpentier was the eclipsed variable; period 4 revolutions in 12 minutes.

By the hyperboreans our expert was looked upon as one suffering from moral obliquity, but time later accorded him the appellation of the prophet of the Mackenzie.

Yes, the Dempsey-Carpentier fight was heralded in the Arctic regions about as soon as in Brooklyn.

The Dominion Observatory participated with Paris, Washington and Greenwich last summer in a wireless longitude determination for Australia in connection with the meridian boundary, 129° East, between South Australia and West Australia. The wireless signals were sent from the Lafayette station at Bordeaux and from Annapolis, and we recorded both.

I may mention that there is under consideration an international wireless longitude campaign around the world, by means of which we expect all countries to link up their longitudes with this international net. We expect to attain such accuracy that a repetition, say in 50 or 100 years, will reveal a bodily shifting of crustal masses, such as the continents, a circumstance that is believed to be and to have been in process for ages. This means that, for instance, America is moving away from Europe. In this international work Canada expects to cooperate, and she is already taking part in the International Astronomical Union which meets in Rome next May, and for which the speaker has been chosen delegate to represent Canada.

Beside the above purely astronomic work in which the Dominion Observatory is engaged, other scientific work falls within its sphere, consequent to the evolution of such work in Canada. We shall now make a rapid review of that work, which may properly be designated geophysics—comprising seismology, terrestrial magnetism and gravity.

Seismology, dealing with earthquakes, we may call the newest of the sciences, for it is only within recent years that we have obtained reliable records of earthquakes, so that we can locate them in unknown regions or in the ocean with a fairly high degree of precision. To give this a more definite meaning let me say that if we have a decent earthquake—one that gets a good grip on the earth to give us a clean record—it can be located, no matter how far away, say within 30 miles. And furthermore, we can determine the actual time to within two or three seconds. The actual time of the occurrence of a destructive earthquake in the Imperial Valley, California, was better determined from earthquake records thousands of miles distant than obtained on the spot.

Fortunately for the determination of the distance of an earthquake three different kinds of waves are simultaneously propagated. Two of them travel through the earth, *i. e.*, dip down into the earth, while the third confines itself to the surface, and each has its own velocity. We may compare these waves to three messengers, starting at the same time to spread the news of the earthquake. From many well-known quakes and their records we have learned the speed of these messengers; two of them have a variable speed—the deeper they delve into the interior, any way to a depth of about a thousand miles, the faster they go. It is obvious, therefore, if we know the difference of time that it takes any of the two messengers to reach us, we know how far they must have traveled to produce that difference of time; hence we know the distance to the earthquake or epicenter, as it is called. To illustrate the principle in another way: An express train and a freight train leave a certain place at the same time, with an average speed of 45 and 30 miles respectively. You note their arrival in New York and find that the freight arrived ten hours later than the express, which will show that each had traveled nine hundred miles, *i. e.*, the starting point was 900 miles from New York. Quite simple. But what isn't always so simple is to read the record, the seismogram, to tell when the second and third meessengers arrived; the first one is generally easy to read because it begins from a state of quiescence of the instrument, but the other two take experience to decipher the hieroglyphs. It's a wonderful story these messengers write on our photographic record; they tell us where they have been, what the nature of the material is through which they passed, its density, its elasticity, a story as fascinating as that of Homer's "Odyssey," but not so easily interpreted. Seismology is the new science that gives and brings us direct evidence of the interior of the earth, and it has definitely shown and proven that the interior of the earth is not and can not be liquid, although at a very high temperature, because through a liquid our second earthquake wave, which has transverse motion, could not be propagated; one can not propagate transverse motion in water, but one can propagate longitudinal motion such as sound waves have, and this is the nature of the first wave to arrive. In a solid both kinds of waves, however, are propagated.

As to the cause of earthquakes: An earthquake is the release of stresses to which the earth is subjected. These stresses are manifold. Some are cumulative like constant denudation, transport of material from the land to the sea; some are seasonal like the polar accumulation of snow, and there are stresses due to the rotation of the earth, temporary loading by atmospheric pressure, to mention but a few of the contributory causes. Their occurrence or adjustment to equilibrium naturally is effected at the parts least able to resist the stress, and these are along fault lines, old sores in the earth's crust that are not thoroughly healed—healed by first intention, as the surgeon would say. We may, therefore, say very broadly: "No fault lines, no earthquakes." Also the newer geological formations where things have not settled down so permanently are more subject to quakes than the older ones. The prediction of earthquakes is by no means a chimerical proposition, in broad outlines, at least.

Before leaving this interesting subject may I be pardoned for saying the Seismological Tables published by the Dominion Observatory are universally used in America and to some extent elsewhere.

As a by-product of the seismograph we have found that it records the pulsation of the ocean waves, *i. e.*, we in Ottawa record every wave of the Atlantic that impinges on the coast from Cape Hatteras to Newfoundland. The period of these waves varies from about 4 to 8 seconds, and on the seismogram they look like saw-teeth. These pulsations are transmitted through the crust of the earth. We have been able to link up these microseisms, called micros for short, with areas of low barometer on the Atlantic Coast. At Ottawa we are about 500 miles from the nearest sea coast, and it seems incredible that we receive through the earth these pulsations of the ocean. We have built and installed at Chebucto near Halifax an instrument which I christened "undagraph" or wave writer, which counts and records every wave of the broad Atlantic reaching the coast of Nova Scotia there, and that record or undagram we correlate with the corresponding seismogram at Ottawa.

The next subject in geophysics of which the Dominion Observatory has charge is terrestrial magnetism. That means the determination of the three magnetic elements, declination or variation of the compass as known to the public, inclination or dip and the magnetic intensity. Our work extends from the Atlantic to the Pacific and we have occupied some five hundred stations at each of which these magnetic elements have been determined. The variation of the compass is the element most wanted—the surveyor needs it, so does the explorer, the navigator and many others. When the poet writes "as true as the needle to the pole," he is guilty of poetic license of a serious kind. If a sea captain were to accept that statement he would never reach his destination. In our work we find for instance on the east coast of Canada the needle points 35° to the west of true north and on Vancouver Island 25° to the east, that is, a range of 60° over Canada, two-thirds of a right angle. It is very obvious that for those that use a compass it is very essential that its declination from true north be known. Unfortunately this is not a constant quantity, but is subject to an oscillating daily change and a slow secular one, both of which are quantities that we determine and apply.

In order to assure accuracy we standardize our instruments twice annually. The most accurate time is furnished by means of a pendulum clock. But why does the pendulum vibrate, or pendulate, to coin a necessary verb? "It can't help itself" would scarcely be a scientific reply. It is the attraction of the earth that tends to restore it to its normal suspended position, the line of action of the earth's gravitational force. This force is affected by the rotation of the earth and the combined effect we call gravity.

The earth is not a sphere; hence points on the surface are at varying distances from the center. Again the centrifugal force due to rotation is greater in the equatorial regions than north and south thereof; in short, for every latitude there is a particular force of gravity, so that a pendulum that would swing or vibrate seconds in Ottawa would not do so here in Brooklyn. It would lose time here. You see you haven't got as much pull here (I am not speaking in a political sense) as we have in Ottawa, but you are more apt to fly off the handle, to use a cant expression, because nearer the equator. From the above statements it becomes evident that the pendulum, an invariable pendulum, gives us a means for determining the relative force of gravity on the earth, and thereby the accurate figure of the earth, its ellipticity, its flattening, as well as anomalies in the distribution of matter in the crust of the earth. This line of investigation is carried on too by the Dominion Observatory and we have about fifty stations distributed over Canada. The period of the pendulum, that is, the time of swing, which is about half a second, is determined to the one tenth-millionth of a second of time; let me repeat ten-millionths of a second of time, and this order of accuracy is shown when observations are repeated at the same place and the interagreement is limited to the units of the seventh place of decimals.

We now know the figure, *i. e.,* ellipticity, with a high degree of accuracy so that we can readily compute what the theoretical force of gravity should be for any given latitude; hence observations there will show the divergence or anomaly for that place, which means that there is an anomalous distribution of matter in and about the crust of the earth. When we speak of crust of the earth, we mean a thickness of about seventy-five miles, which brings us to the stratum of equilibrium or compensation.

All mountains practically float in the earth, the ten or twenty thousand feet or more that they tower above sea-level are not supported by the crust it couldn't do it but they float like an iceberg does in the ocean, which displaces as much water as its own mass above and below water.

These gravity observations have disclosed some interesting facts about what is hidden underground, by the amount of gravitational force or pull that the hidden mass or masses exercise. If there are huge deposits of iron ore, for instance, gravity would be increased, while large deposits of oil or gas or salt would have the opposite effect. The pendulum thus becomes a scientific divining rod. We may well say—a peculiar concatenation—from the stars we bring to earth accurate time, and that time we use to express gravity, and from the latter divine oil. Perhaps it is fairer to state that the positive statement of the pendulum is when there is an excess of gravity, oil can *not* be present, for that always involves a defect of gravity.

But there is a more delicate and more sensitive instrument for measuring differential gravity, and that is the torsion balance, by means of which actual areas can be mapped out underground occupied by oil or gas or salt, which has recently been achieved in Europe, especially in Hungary. I am glad to state that such an apparatus is now being built for the Dominion Observatory, and it will be, I believe, the first in America for that purpose.

I shall refer to one other geophysical investigation in which we were engaged. Sir George Darwin many years ago concluded that the earth was subject to daily physical tides, beside those of the ocean, *i. e.*, that the earth was squeezed, was deformed by the action of the moon, which is the main factor in our ordinary tides.

Darwin tried to measure the minute quantity, but failed on account of disturbing factors on the surface of the earth. Hecker of Potsdam succeeded by having his instrument in a deep shaft beyond the effects of the daily heating of the earth, in obtaining a value, but there was the anomaly, found too by the Russian Orloff, that apparently the earth was more readily squeezed in a north and south direction than in an east and west direction. The question was referred to Professor Love, probably the foremost exponent in questions of elasticity, but no satisfactory solution was obtained. It was believed that possibly the situation of the observing stations with reference to the ocean might play a part by the gravitational effect of the tide or heaped-up waters upon the horizontal pendulum which was the instrument used, and also by this same mass of water bending the ocean floor and producing slight tilting of the instrument. To settle this the International Seismological Society decided to establish several stations widely differing in their positions with reference to oceans. Canada was assigned a station. The war intervened, and we never met again. However, the problem was attacked by Michelson of the University of Chicago and brilliantly carried out on the grounds of the Yerkes Observatory and in quite a different manner, by observing in 500-ft. 6-in. pipes partly filled with water the change of level. For measuring the minute quantities an interferometer was used, that is, the wave lengths of light were the measuring rod. It was found that the earth responds practically instantaneously to the action of the moon. The earth as a whole has about the rigidity of that of steel. The surface of the earth rises and falls about a foot twice a day, due to lunar and solar attraction. We are sitting on a long ''teeter''—6,000 miles long, with a period of a little over twelve hours—unconsciously teetering. It doesn't seem much, yet in it is bound up the constitution of our earth, and of all objects in the universe what concerns man more than the earth?

And now I have done. I have given you a brief outline of ''Astronomy in Canada'' the title of my address, together with other scientific work carried on by the Dominion Observatory. Euclid's definition of a point is that which has position but no magnitude—with Canada it is about the reverse with much emphasis on magnitude. We are trying to give it position—a prominent place on the map of a progressive world—a place in the sun—and I am sure you good people to the south of us, who have been basking in sunshine these years, will welcome the kindred spirit from the north, where we are trying to advance knowledge and advance the various fields of development in which we are engaged, so that our work may be a credit to Canada and a benefit to mankind.